

MUSKINGUM RIVER, OHIO.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING

A report upon the Muskingum River, Ohio.

JANUARY 30, 1879.—Referred to the Committee on Commerce and ordered to be printed.

WAR DEPARTMENT,
Washington City, January 29, 1879.

The Secretary of War has the honor to transmit to the House of Representatives, in compliance with section 2 of the river and harbor act of June 18, 1878, a copy of report of Maj W. E. Merrill, Corps of Engineers, upon survey of the Muskingum River, Ohio, with letter of the Chief of Engineers submitting the same.

GEO. W. McCRARY,
Secretary of War.

The SPEAKER of the House of Representatives.

OFFICE OF THE CHIEF OF ENGINEERS,
Washington, D. C., January 28, 1879.

SIR: In obedience to the requirements of the second section of the river and harbor act of June 18, 1878, I have the honor to submit the inclosed copy of a report upon the survey of "the Muskingum River, Ohio, below the second dam, to ascertain its adaptability for an ice-harbor for the protection of steamers and other craft on the Ohio," with estimate of cost of improvement proper to be made.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Brigadier-General and Chief of Engineers.

Hon. GEO. W. McCRARY,
Secretary of War.

SURVEY OF MUSKINGUM RIVER, OHIO, BELOW THE SECOND DAM, TO ASCERTAIN ITS ADAPTABILITY FOR AN ICE-HARBOR FOR THE PROTECTION OF STEAMERS AND OTHER CRAFT ON THE OHIO RIVER.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, January 20, 1879.

GENERAL: I have the honor to submit the following report on the survey of the mouth of the Muskingum River, Ohio, as a harbor of refuge.

The present natural mouth of the Muskingum, between the railroad-bridge and the Ohio River, which contains a harbor area of about five acres, is probably the best ice harbor between Pittsburgh and Cincinnati, and it is usually filled each year to the full extent of its very limited capacity. It is the customary winter harbor of the United States dredge-boats Ohio and Oswego, and they and their scows are lying there at this present. I had some thought of also selecting it for wintering the snagboat E. A. Woodruff, but the danger of fire among a crowded mass of helpless steamboats made me decide to send her elsewhere.

Just above the railroad-bridge the Muskingum River is crossed by a dam, built about forty years ago by the State of Ohio. This dam makes a pool more than five miles in length, with ample depth and width.

It is therefore evident that if some satisfactory communication be made with this pool there will result a harbor of refuge of ample capacity for all the boats and barges that will probably need it.

The lock that now communicates between this pool and the Ohio River is located on the wrong side of the river and is entirely too small, being only 130 feet long and 35 feet wide. The channel leading to it is narrow and hardly susceptible of enlargement, as, where it is crossed by the railroad-bridge, it is reduced to a width of 38 feet between massive masonry piers. The lock itself is built in an inferior manner and is badly out of repair. It is evident that a new lock is a necessity, and it is equally evident that it is better to build it on the Marietta side of the river.

The dimensions selected for the new lock are 400 feet in length between miter-sills, and 56 feet in width. The object of these large dimensions is to enable a steamboat with two barges to enter the lock at one time. The use of the proposed ice harbor will be greatly restricted if the lock is not made large enough to permit this to be done. It is also proposed to set the lower miter-sill so as to have four feet over it during low-water in the Ohio. The lower miter-sill of the present lock has one foot less of water over it at that stage than there is in the channel, and boats that could pass from the Ohio into the pools of the Muskingum and *vice versa* are stopped by their inability to cross this barrier.

It is also essential that the eastern fixed span of the railroad-bridge be replaced by a pivot-draw. By this means two draw-spans with clear openings of 65 feet can be secured. As these openings are 9 feet wider than the proposed lock they evidently give ample provision for commerce.

If these changes are made it is proposed to retain the present length of dam by building across the present lock, thus compensating for the part of the dam that must be taken away by the new lock. The small draw-span over the outlet from the present lock may be fastened in place and used as a fixed span.

As the proposed new lock will cut off the inflow to the race of the flour-mill on the Marietta side, it is the intention to replace this open cut, which is always a source of danger in high-water, by masonry inlet-culverts with suitable valves. This change will greatly add to the safety of the dam.

The aggregate cost of the above work is estimated as follows:

New masonry lock, 400 by 56 feet	\$143, 000
New masonry inlet to mill-race	16, 000
Extending dam through present lock	2, 000
New iron draw-bridge, with pier	30, 000
Engineering and superintendence	9, 000
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	205, 000
Contingencies, 10 per cent	20, 500
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Total	225, 500

This includes nothing for land, as it is presumed that if any is needed it will be gladly donated.

The cost of the proposed lock is larger than it would have been had the foundation been better. As rock cannot be reached, it is proposed to support it on bearing piles, capped by a timber and plank platform, surmounted by a monolithic layer of concrete. Filtrations under the lock will be prevented by a liberal use of sheet-piling, and lateral-scour outside of the river-wall, by retaining and strengthening the coffer-dam used for its construction.

It is possible that the company owning the bridge might be willing to contribute somewhat to the cost of the new draw-span.

Further details will be found in the report, hereto annexed, of Mr. Thomas P. Roberts, assistant engineer, who served for some years as principal assistant engineer on the Ohio River improvement, and whose services I was fortunate enough to secure for the present survey.

Three maps accompany this report.

Very respectfully, your obedient servant,

WM. E. MERRILL,
Major of Engineers.

Brig. Gen. A. A. HUMPHREYS,
Chief of Engineers.

REPORT OF MR. THOMAS P. ROBERTS, ASSISTANT ENGINEER.

PITTSBURGH, PA., December 28, 1878.

COLONEL: I herewith respectfully submit my report upon the surveys for a harbor of refuge at the mouth of the Muskingum River, Ohio, which work I began under your instructions August 28, and finished September 23, 1878.

The object of the survey was to investigate the advantages which the mouth of the Muskingum River affords as a harbor of refuge or place of safety in which vessels navigating the Ohio River might find shelter at periods when the annual break-up of ice on the Ohio makes it hazardous to remain in that river. The number of steamers, barges, and flatboats engaged in transportation on the Ohio is very great, and the losses by the destruction of these various crafts every year by ice make it very desirable to have some means of avoiding such disasters. There are few places on the upper portion of the Ohio River itself which, either by nature or by art, have been rendered exempt from the destructive power of the ice. The break-ups in the Ohio are not, however, always dangerous, neither are they regular in their periods. Sometimes the ice forms and passes off without occasioning serious loss, and sometimes there may be one or more very serious break-ups during the same winter. It is certainly true that the river-men, always eager to avail themselves of good navigable water, will risk their boats so long as the river is open. Thus it happens that in sudden cold snaps vessels navigating the Ohio are caught away from harbors of refuge and must needs take shelter from the threatening dangers in the first place which appears to offer protection. Once frozen in they must wait the natural process of being thawed out and run all the risks of buffeting the ice when it gets in motion. Very frequently this ice comes down in large sheets 2 feet or more thick, mixed with which are often seen solid blocks of "gorge ice," which have been thrown out by tributaries, and which float along like miniature icebergs and with almost the same irresistible force. Should the break-up be accompanied with rain the river rises to a flood volume and the ice

carried upon its bosom penetrates behind islands into places usually accounted safe for boats and cuts down whatever craft it may meet.

Above Louisville it has been observed that the northern tributaries of the Ohio, as a general rule, do not break up so early as the main river, hence the mouths of these streams are preferred for places of shelter. The Muskingum River, which enters the Ohio 172 miles below Pittsburgh and 294 miles above Cincinnati, is the most important northern tributary above the mouth of the Wabash. It drains about 12,000 square miles, embracing in its basin nearly one-third of the State of Ohio. Its sources are within 20 miles of the shores of Lake Erie, and hence they are subject to the climatic influences of the lake region. Its basin upon the whole has an average temperature considerably colder than that of the Ohio Valley above the mouth of the Muskingum. Its mouth being wide and situated at a point about midway between the great commercial ports of Cincinnati and Pittsburgh, is sought on the approach of hard freezing weather as a harbor by steamers from points as far up as Wheeling (82 miles above), and by all upward-bound boats which can reach the haven which it affords. Unfortunately, but a small area of the Muskingum is available for a harbor, for 750 feet above its mouth it is crossed by a railroad-bridge elevated only 42 feet above low-water surface, and 300 feet above the bridge is located the first dam of the Muskingum slack-water improvement. The bridge is provided with a draw-span admitting boats to the lock in the dam, but the opening is only 38 feet wide, and the lock itself is only 34 feet wide and 180 feet long, which dimensions are entirely too small for the great majority of the steamers now engaged in the navigation of the Ohio. The improvement of the Muskingum was undertaken 40 years ago by the State of Ohio, and of course the size of the locks was not planned with reference to the demands now sought to be imposed upon them.

No accurate records have been kept of the number of steamers, towboats, and barges which have annually sought the mouth of the Muskingum for a harbor of refuge. The mouth of the river is used every year, but no one seems to know the precise number of boats wintering there. All my informants agreed that it is a common occurrence to have the area below the bridge filled with steamers and barges. What passed under every one's observation no one seems to have thought worthy of note. However, I learned that in the winter of 1856-'57, 18 packets lay up at this point. Some of them remained frozen in for 4 months, the winter proving a very severe one. The break-up occurred on the 1st of March and extended as far down as Cincinnati. It was not until the 21st of March that the break extended up-stream as far as Pittsburgh. The ice froze at Marietta that winter 22 inches thick. The Muskingum ice did not pass out until the Ohio was entirely clear. It was during this winter that the packet steamer *Caledonia* after having been safely sheltered in the Muskingum, proceeded adventurously to stem the ice in the Ohio before that river was entirely clear, but she was cut down and sunk before she had made 300 yards up-stream. It occasionally happens that the ice in the Muskingum breaks up on its lower pools before that on the Ohio; this has occurred three or four times in the last 40 years. Upon one of these occasions a number of boats, as usual, were tied to the piers of the railroad-bridge, nearly filling the harbor below, but the ice was so much broken up in its passage over the dam that it did no damage to the boats. There is no record of a single mishap to any boat on the Muskingum River by ice in the forty years' experience of the slack-water improvement, which fact alone furnishes a strong argument in favor of the improvement of navigable streams.

Of late years an increasing amount of the business on the Ohio has been done by means of towboats with fleets of barges, so that while there are not, perhaps, as many steamers, particularly of those engaged in the passenger business, on the river as formerly, the aggregate number of vessels and the aggregate tonnage is much greater. It is therefore chiefly *towboats* and *barges* which in future will seek this harbor. I was shown a photograph of the harbor, taken about 8 years ago in the winter season, in which I counted 5 steamers with 20 or more barges all frozen in and waiting for the ice in the Ohio to pass out. During the winter of 1876-'77 there were 5 steamers and a number of barges at one time in the harbor, and at one time last winter there were as many as 11 steamers with a number of barges moored below the railroad-bridge. At the date of this counting (December 28), no less than 12 steamers are laid up at Marietta. But the area now available is so limited, that, as has been very justly observed, a conflagration once begun among these boats would be followed by the destruction of the entire fleet, as well as by the probable destruction of the bridge, the two mills, and other valuable property adjoining.

I am satisfied that the number of vessels which have sought this harbor is not a safe criterion of its possible value, because it is known that the space is entirely inadequate for the reception of more than three or four of the largest sized fleets of barges, and that by no possibility can they reach the pool above the dam. For this reason towboatmen do not make it an object to seek it as a place of safety. For vessels of this class a large area must be provided. These steamers with their fleets generally leave Pittsburgh in detachments upon every freshet. As many as 50 fleets numbering altogether over 400 vessels have left Pittsburgh in 48 hours, and although they do not all

arrive home again within the same limited period, it is not uncommon for more than a dozen steamers, towing, say, 100 barges, to get back on the same day. Considering, therefore, the method in which the towing business on the Ohio is done, it is quite evident that the natural harbor at Marietta is entirely too small for the demands of the trade, and that a harbor with a capacity for at least 200 steamers and barges is needed, in order to fully provide for the wants of commerce.

THE PRESENT HARBOR AND PROPOSED IMPROVEMENT.

The mouth of the Muskingum just below the railroad-bridge measures about 600 feet in width at the surface of medium low-water. But some piles which were driven several years ago to confine the current, with the expectation that the water would remove the gravel bar that lies lower down in the mouth of the river, diminish the available width to 470 feet. The railroad-bridge crosses the river 750 feet above its mouth, leaving, therefore, a space of only 750 feet long by about 500 feet wide, or a trifle over 9 acres. From this area must be deducted about 4 acres for the bar or shoal leaving only 5 acres below the bridge which can be relied upon as a harbor. The inadequacy of this space is at once apparent when it is understood that an ordinary towboat with its fleet of barges occupies more than one acre, so that at this rate there would be harbor-room for only five such fleets. There is an additional space between the bridge and the first dam on the Muskingum, which is situated 300 feet above the bridge, but as the bridge is only 42 feet in clear height above low-water, it is too low to permit the passage of any of the steamers, and were it higher the violence of the current below the dam when the water is passing over would forbid the use of much of this space.

It is therefore desired by the river-men that a wider draw-span be placed in the bridge, and that a new lock be built at the dam large enough to pass the steamers with barges through to the pool above. This pool has a length of $5\frac{6}{10}$ miles to the second dam, with an average width of 510 feet, affording an area of about 350 acres. Our survey showed this pool to be of ample depth, so that steamers can approach the shores nearly all the way up to Devol's dam. There is here, therefore, abundance of room for a first-class harbor of refuge.

CONDITION OF PRESENT WORKS.

The locks and dams on the Muskingum were constructed in 1838 by the State of Ohio. The slack-water extends to Zanesville, 65 miles, in which distance there are five locks. There are five steamers plying on the pools of the Muskingum, four of which form daily lines between Marietta and Zanesville, and between Marietta and Beverly, the fifth being employed between McConnellsville and Zanesville. In addition to the above, boats have for years made weekly round trips between Pittsburgh and Zanesville, and occasionally towboats, with coal and coke, ascend the river.

The city of Marietta, with 8,000 inhabitants, occupies the left bank of the river, at its mouth, and opposite to Marietta is the handsome town of Harmar, containing a population of over 1,000. In the location of the first dam a dispute arose as to the side of the river on which the lock should be established, which was finally settled in favor of Harmar. The location of the lock on the Harmar side was unfortunate, for the natural channel of the river is now and always has been down the east or Marietta side, which has a slightly concave shore. To remedy the difficulties attending the maintenance of the channel from the lock to the draw-bridge along the Harmar side, there being a tendency of the river to form a deposit on that side, it became necessary to drive piles, so as to confine the waste water from the lock in a canal. After passing the draw-bridge the channel, being no longer confined by the piles, turns almost at right angles to the Marietta side, and thence continues down that shore to its junction with the Ohio. It is said, by old citizens of Marietta, that in early days the mouth of the Muskingum was scarcely more than one-third of its present width, and that the "tall scycamores nearly interlocked their branches over its mouth," which was then for some distance up 16 feet deep along the the Marietta shore. There is no doubt of the fact that the river was formerly much narrower at this place, for old Fort Harmar with its parade-ground occupied the site of the bar and the space between it and the Harmar bank.

The lock was constructed of masonry, with side walls 8 feet thick. The walls at their lower ends measure 19.1 feet in height above low-water surface in the Ohio. At their upper ends they measure 24.7 feet above the same datum, or 13.3 feet above the comb of the dam. The lift of the lock is $11\frac{1}{2}$ feet, the chamber being 180 feet long and 34 feet wide. The depth on the lower miter-sill is one foot less than the channel depth below and in the Ohio River, so that in periods of low-water it sometimes occurs that boats able to navigate the river below cannot enter the lock for want of a sufficient depth on the miter-sill. To obviate this difficulty recesses were left in the ma-

sonry of the piers at the draw-bridge, 280 feet below, for the purpose of hanging gates which, when closed, would pond the water in the canal and in the lock-chamber sufficiently deep to admit boats, but for some reason the gates were never put in place.

The masonry of the lock rests on planks which were laid on the gravel, no piles having been driven to support the foundation. As might be expected under such circumstances the scour created by leaks underneath this flooring has caused a settlement of the walls amounting to as much as 1 foot in the river-wall at one place. Several years ago, on account of the settlement, it was found necessary to remove about one-third of the land-wall and replace it with timber crib-work. The lock is so much out of repair and in such a condition that it may properly be called a ruin, though as the gates are kept in order and work freely it still remains of great value. The premature decay of such an important work is to be solely attributed to the too common practice of sacrificing stability for economy in first cost.

Originally the dam was constructed on the gravel in the same manner as the lock, and in 1866 200 feet of it washed out, but it is claimed that the accident was caused by the dam tumbling into the excavation created by the scour below and not by leaks underneath. However this may be it is certain that pile-work foundations would not so easily have toppled over. The break occurred at a point beginning 60 feet from the Marietta side, and it was followed by a scour which extended to the depth of over 20 feet in the gap. I was interested to know whether the scour had extended at that time to the bed-rock, but the evidence was conflicting on this point. The new portion of the dam rests on piles. Whatever may be the depth to the rock at this place, I am satisfied that it is beyond reach for economical construction upon it. The bridge-piers and the mills in the neighborhood all rest on piles driven to the depth of 16 to 18 feet through the gravel and sand, and have stood the test of time very well.

Considerable apprehension has been felt at times that a flood in the Muskingum might wash out the banks around the lock, or around the abutment on the Marietta side, an occurrence which has happened to two of the dams above. The likelihood of such an accident occurring at Marietta may not be very great, from the fact that the Ohio is generally high at the same time as the Muskingum, and it is only the floods from the Ohio which pond back the water over the banks in the lower portions of the two towns. Still the arrangement of the mill-races, particularly the one on the Marietta side, tends to weaken the bank at a very critical point. Some piling and ripraps have been employed on that side to arrest the further erosion of the banks.

I merely call your attention to this matter to show the expediency of designing some safer arrangement for supplying the mills with water. The mill-race on the Harmer side leads directly from the head of the lock through a timber conduit 20 feet wide and 4 feet high. This conduit is covered and passes parallel with the land-wall of the lock and 13 feet distant from it, and it is possible that the early settling and destruction of that wall was expedited by leakage from the culvert. The mill-owners lease their water from the State. The two mills are important and valuable properties, worth not less than \$45,000, having a capacity of over 300 barrels of flour daily. I believe, however, that it is possible to design a new lock which will not interfere in any way with the operations of the mills as now located, excepting possibly at times during the progress of the work. But as the Marietta mill, the one concerned in the new project, has a reserve of steam-power, for use in periods of high-water, no serious trouble with the owners need be apprehended, in case the government should conclude to construct the proposed work.

THE WORK PROPOSED.

For the special purpose of admitting boats into a harbor of refuge, locks of a smaller size than those proposed for the Ohio will probably answer the purpose. Nearly all the steamers on this part of the river are stern-wheelers, a style of boat somewhat narrower than side-wheel boats of the same tonnage. All the Pittsburgh towboats are stern-wheelers, and none of them are over 45 feet beam and 250 feet long. The boats in the Pittsburgh and Cincinnati packet trade, of which there are now five in one line, as well as all the other passenger-steamers from Pittsburgh, are stern-wheel boats. The widest steamers are those in the Wheeling and Cincinnati trade, one of which is said to be 55 feet wide. There is now being built at Wheeling, however, a side-wheel boat 65 feet wide (over all) and 275 feet long, for the Cincinnati trade from that city.

As I have proposed a new lock with chamber 400 feet long by 56 feet wide, the boat last mentioned would be the only one which could not enter it. Experience has demonstrated the superiority and economy of stern-wheel boats on the shallow waters of the Upper Ohio, so that to design a very large lock for this place simply to accommodate the very few exceptionally wide boats on the Upper Ohio would be neither wise nor economical. Besides there will always remain ample room below the lock to shelter the few boats which may hereafter be constructed too wide for admission into a lock of the dimensions proposed.

The length of 400 feet seems advisable in order to enable towboats to be locked

through in company with several of their barges. In case of a rush of the larger tow-boats with their fleets to the harbor, the large boats could enter first, take two barges with them, and pass into the pool, leaving the remainder of their fleet to be brought through in two or more detachments by some smaller boat, as is done constantly at the locks on the Monongahela River.

It will be seen by the accompanying maps that the river-wall of the proposed new lock passes across the part of the river-bed scoured out by the wash from the dam. The deepest point on the line of the new work is shown to be 17 feet below low-water. The bottom is composed of fine gravel and sand, or such material as is carried in suspension over the dam. The depth of this deposit to the rock is unknown, but I believe the scour sometimes extends to the depth of 23 to 25 feet below low-water surface. I made some soundings after a sudden flood which indicated a scour or change of depth of several feet in a few days, but up to the time I left Marietta it was impossible, owing to the violence of the current, to take accurate soundings. Our regular survey had been made before the flood, when the water below the dam was as calm as a pond, and with no appreciable current.

In case of necessity, I believe the scour can be arrested by pinning mattresses to the bottom and having them weighted with stone. There will be no doubt a tendency in the river to undermine the cribs or piling which may be used to surround and protect the foundations of the lock, and it would probably be best as an additional precaution to support such works on the side next the current with large riprap stones, which are easily obtained at the quarries in the neighborhood.

If a coffer-dam is employed in constructing the lock, it would probably not be necessary to inclose the land side of the walls. But it may be remarked that the depth of the water is quite considerable through which to carry a coffer-dam.

Your preference, expressed orally to me, of plans for founding the lock-walls, and, in fact, the entire lock-chamber, on a bed of concrete, making that a "monolith" to rest on piles, is, I think, the best that can be proposed for such a situation. With that idea in view, I would respectfully propose for your consideration the following plan of operations:

First. That a double row of close piling be driven from the dam downwards, parallel with the proposed lock-chamber and thence to the shore below, the object being to prevent the escape of the inclosed material. That, after being driven, the space between the rows, which might be 10 feet apart, be excavated as nearly as possible to the extreme depth of the scour. The piles then to be driven deeper, if they will go any deeper, and sheet-piling to be used occasionally where its addition would add to the imperviousness of the structure. The rows of piles then to be strongly braced and tied together and filled with broken stone. The river side to be protected by large blocks of stone. The piles finally to be cut off evenly near the surface of low-water.

For the portion of the chamber *above the dam* I would propose that it be inclosed with a tight coffer-dam in the usual manner.

The entire area inclosed then to excavate to the required depth, or filled where too deep to the proper height, and the bearing piles at intervals of 4 feet to be driven throughout the chamber. These piles to be cut off about 7 feet below the surface of low-water, and two courses of flooring timbers framed, bolted, and floated over the desired position. Before sinking the floor I would suggest that it be first sided up to the height of 12 feet, somewhat in the manner of coal barges, so as to be water-tight, and that the floor be covered with tarpauling to prevent the concrete from seeping through it. After being gradually sunk with the concrete, which should be 3 feet deep over this floor, a few outside piles might be driven at intervals and bolted to the sides of the box in order to aid in supporting them against pressure, after which the chamber can be pumped out preparatory to laying the masonry.

While the outside piles or crib-work protection may not cost any less than a coffer-dam, this plan at least is free from the risks that would be attendant upon that method of construction in a place where a light sand and ground bottom is subject to the erosion from the overfall of a dam now in existence. I witnessed the water pouring over this dam when it presented a breast of 9 feet deep and 530 feet long, and it created such a maelstrom below, that large trees would disappear in the depths and emerge at random a hundred feet or more farther down. It is easy to imagine that such materials, propelled with such force, may, even in the limited period of their submergence, plow up the bed of the river with great effect. I have said enough, however, to call your attention to the difficulties of the place, and suggest the above plan, which I think will meet them.

The exit below, from the proposed lock, passes straight down the Marietta side on an easy line to the bridge. Below the bridge, the removal of the piles, and a little dredging not exceeding 2,000 cubic yards, will continue the channel nearly straight to the Ohio River.

After the new lock is built it would be of advantage to entirely remove the old lock and extend the dam on that side to the shore, thus preserving almost the same length of dam as exists at present, and therefore not increasing the liability to "cut around,"

or overflow the bottoms, which dams, built to confine the natural width, always have. And further to prevent all possibility of a cut-around on the Marietta side, the land-wall of the new lock, in accordance with your suggestion, and as shown on the map, is extended up-stream and thence turned into the solid bank above the entrance to the mill-race. Through this wall culverts provided with valves can be set which can be arranged to thoroughly regulate the flow of water to the mill. With this plan it would be safe to turn the mill-race directly down to the mill. But in case this is done I would suggest that the water-course be puddled to prevent leakage. The present course of the mill-race which extends a square back into the city, and is thence, with two right-angle turns, brought to the mill, could be filled up, and an unsightly place in the neighborhood of Marietta's beautiful park be made more inviting. In addition the park could be extended along by the locks to the mill.

The only objection to locating the lock as proposed, arises from the fact that the Marietta and Zanesville packets have their landing at the foot of the street just above. But it should not be forgotten that during much of the year there will be little use for the proposed new lock, and that, therefore, they could land at that place as usual.

To complete the plan of forming a harbor of refuge at Marietta there remains only the matter of transforming the Marietta span of the Marietta and Cincinnati Railroad bridge into a draw-bridge. This span is 160 feet in the clear opening, so that a 30-foot circular pier in its center would leave for the opening on each side a width of 65 feet, or 9 feet more than is actually necessary to pass boats of the full width of the proposed lock. The change can be made without seriously incommoding the business of the railroad. The road terminates immediately upon crossing this bridge and reaching the main street of Marietta, one square distant from the bridge. The freight station and shop is located on the Harmar side. The bridge is also used as a highway for wagons and foot-passengers. The track of the Cincinnati road connects in Marietta with the Duck Creek Valley Railroad, which is the outlet for the north, but the transfer of freight between these roads is comparatively small.

Of course, if necessary, the change in the railroad-bridge can be effected without stopping its use at all. I have mentioned the facts of the case merely to give a correct understanding of the position of affairs.

The city of Marietta owns the ground which would be occupied by the lock and its appurtenances, and no doubt would invest the United States with a clear title to all the space required. I was informed, also, that the State of Ohio would enter into any arrangement which the United States Government might desire regarding privileges to navigators desirous of using the lower pool of the Muskingum River improvement as a harbor of refuge.

My estimate of the cost of the work on the plan proposed amounts to \$205,000; which figures include, besides the cost of the new lock, and changes to the old dam, the cost of converting the Marietta span of the railroad-bridge into a draw-bridge.

Respectfully submitted.

THOMAS P. ROBERTS,
Assistant Engineer.

Col. WM. E. MERRILL,
Corps of Engineers, U. S. A.

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